



DET NORSKE VERITASTM

SURVEY REPORT FOR LAND BASED TEST OF
TROJAN MARINEX BWT SYSTEM

TROJAN TECHNOLOGIES

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MANAGING RISK


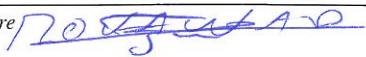
Survey report for land based test of Trojan Marinex BWT system			DET NORSKE VERITAS AS		
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<p>Summary:</p> <p>This report summarizes a land-based test survey of Trojan Marinex BWT system at the DHI facility, Hundested, Denmark. Installation and operation, was verified according to QAPP for land-based testing with 8 pending comments.</p>					
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1 EXECUTIVE SUMMARY

DNV surveyor attended the land-based tests of Trojan Marinex BWTS, 2013-04-18 at the DHI test facilities in Hundested, Denmark.

The tests are part of the Type Approval process for the Trojan Marinex BWTS according to the G8 Guideline of the Ballast Water Management Convention (MPEC.174(58)). The survey covered as well requirements in US Coast Guard rules (USCG CFR 46 Part 162).

The system treats the water by filter and and UV – irradiation during uptake. At discharge the water bypasses the filter and is treated by UV irradiation, only.

DHI was responsible for running the system and for biological and chemical sampling and analysis.

The survey included:

1. Inspection of the Ballast Water treatment unit and the control system.
2. Monitoring the operational performance of the BWMS during ballasting.

Following the survey DNV require the following:

1. Update of QAPP according to QAPP Approval Letter (ref. /1/).
2. Copies of all hand logs and a final report of the tests from DHI submitted to DNV.

2 INTRODUCTION

The land-based tests on Trojan Marinex BWTS were performed at the DHI facilities in Hundested, Denmark with 2 separate ballasting cycles on the 2013-04-18.

The survey was performed by Andreas Cappelen (Engineer).

Flemming Kofoed from DHI was responsible for operating the BWMS and ballasting operation. Mette Albrektsen and Gitte Petersen from DHI were responsible for the sampling, analyzing, transporting and storing of samples.

The land-based tests of Trojan Marinex BWTS was the two first brackish water test in a planned test sequence of 10 tests in total. The intended treatment rated capacity (TRC) was 500 m³/h.

DNV had available a copy of the QAPP prepared by DHI prior to the survey.

3 MAIN PART OF REPORT

3.1 Initial survey

Prior to the test an initial survey was conducted by the attending DNV Surveyor. DNV surveyor had available a generalized PID - DWG nr. MX0057. The surveyor was accompanied by Engineering Manager – Glen Latimer around the site and in the container where the BWTS was placed.

All critical valves and sensors described in the PID were present in the assembly. In addition a control cabinet, lamp driver cabinets, pneumatic cabinet, hydraulic cabinet and power distribution cabinet was present in the container.

UV-intensity (UV-I) and flow were setup to be logged online. Back flushing flow was not logged directly, but was available on a screen in the container, verified by deviating net flow from gross flow. The power consumption is to be provided after the test by Trojan.

The BWT unit was sealed before initiating the tests, to avoid unreported maintenance. This was done by Celina Isen, from Trojan Technology and witnessed by the attending DNV surveyor and Gitte Petersen, project manager from DHI.

A screen-shot showing the control system software revision, can be found in appendix 1 of this report. A Krohne flow meter and UV –DVGW intensity sensor was used for the test.

The flow meter was placed after the UV chamber. This gave a net flow measurement of the flow, evaluated to be the most conservative way of measuring the TRC exposed to the UV chamber.

3.2 Operation

Relevant piping was flushed before both tests and the automatic warm up sequence of 30 minutes was initiated by the operator. The water did not flow continuously to drain but was stored in the cabinet for the 30 minutes. Before the warm up was initiated an automatic mechanical cleaning mechanism was run on the quartz glasses.

The first test, B1 was run from TKD (capacity of 762 m³/h) to tank C1 (capacity of 250 m³/h). Test B1 finished to hold a volume of 212 m³/h in C1 and 491 m³/h in TKD tank.

The second test B2 was run from TKD to tank B1. The holding volume of the tanks was noted by DHI.

The back flush initiation was set to a differential pressure of 0,25 bar.

2 alarms, both visual, one also including a sound alarm were frequent during test B2 and voided by the operator. The control panel signaled “lamp yend leakage warming” and “Filter cleaning failing”. DNV surveyor asked the operator what the alarms signaled, and got indications that the operator did not know what the condition of the alarm was based on. The alarms indicated moisture conditions in the container and frequent back flushing of the filter, intending to warn the operator that the water was

challenging and might result in not complying with D2 and USCG discharge standard. DNV surveyor evaluated neither of these alarms to be of operational or SHE danger and should be considered removed or labelled differently for commercial use to avoid misunderstanding.

The operational sequence of the BWMS, including warming up of the UV lamps, ballasting and back flushing was fully automated, not requiring any guidance from the operator. The readiness of the system was evaluated to be adequate.

The UV intensity was configured to deliver 100% constant capacity, resulting in a constant UV intensity of around 60 mj/cm².

The manufactures representatives; Glen Latimer and Celina Isen, were present during the test. Before start-up of the operation the manufacturer's representatives instructed the operator how to run the test. DNV surveyor made it clear that the consequences of any interference or communication between the operator and manufacturers' representatives during the test would lead to noncompliance with USCG § 162.060-26 (b). No such communication was done during the test run and DNV surveyor evaluated the test to be run solely by the operator with no interference or guidance from manufactures representative.

3.3 Cycle test duration

The test was run over approximately 30 minutes to deviate from 60 minutes required in ETV protocol 5.4.5 (ref./2/). This deviation was known before the test and accepted by Trojan Technology.

3.4 Flow

The flow of both test B1 and B2 was stabile on 430- 460 m3/h. this was due to a near constant back flushing of the filter, with a rate of over 100 m3/h. The unexpected high frequency of back flushing could be related to the exceptional challenging water, expected to contain 5 times required amount of testing organisms over 50µm.

3.5 Water conditions

The water was observed to be under 10°C and, DHI informed that the salt content in the water was just below 20 PSU. DHI informed that the number of organisms over 50µm was indicated to be 5 times over the required to make sure that all organism groups mate the required cut off.

3.6 Sampling

Sampling was done retrieve measurements of POC, TSS, DOC in the lab, and online monitoring of Temperature, DO, pH, UV-T and NTU was done. The samples were transported to the lab, after the test.

The sampling points were evaluated to be according to ETV Protocol 5.3.2.6 (ref. /2/).

4 CONCLUSIONS

Running the Trojan Marinex BWTS system was performed by DHI as according to USCG § 162.060-26 (b). The survey did reveal the following discrepancies with G8 or USCG:

According to USCG § 162.060-26 (f) and G8 Annex Part 2, section 2.3.4 the BWMS must be tested at its rated capacity. According to QAPP, TRC is 500 m³/hr for Trojan Marinex BWTS. This TRC was not obtained for the test cycles.

According to ETV protocol 5.4.5 (ref./2/) the test period should be at least 1 hour. The test period was less than one hour. To maintain the required flow for 1 hour with the holding volume available at the test facility is not possible.

Uncritical events related to the running of the system should be labeled with a more intuitive explanation on the control panel.

The readiness of the system was evaluated to be adequate.

The validity of the land-based test is pending on the outcome of the biological test results. The net-flow through the system must be increased to count as a valid test for the intended TRC of 500 m³/h. In addition, the QAPP must be amended to include all missing information in the SOP from the approval letter (ref. /1/).

5 REFERENCES

- /1/ Approval letter: TNANO386/CAPPEL/262.1-009316-J-27, dated 2013-04-17.
- /2/ ETV Protocol- EPA/600/R-10/146, September 2010

6 APPENDIX 1 – SCREEN SHOT OF THE CONTROL PANEL SOFTWARE REVISIONS.

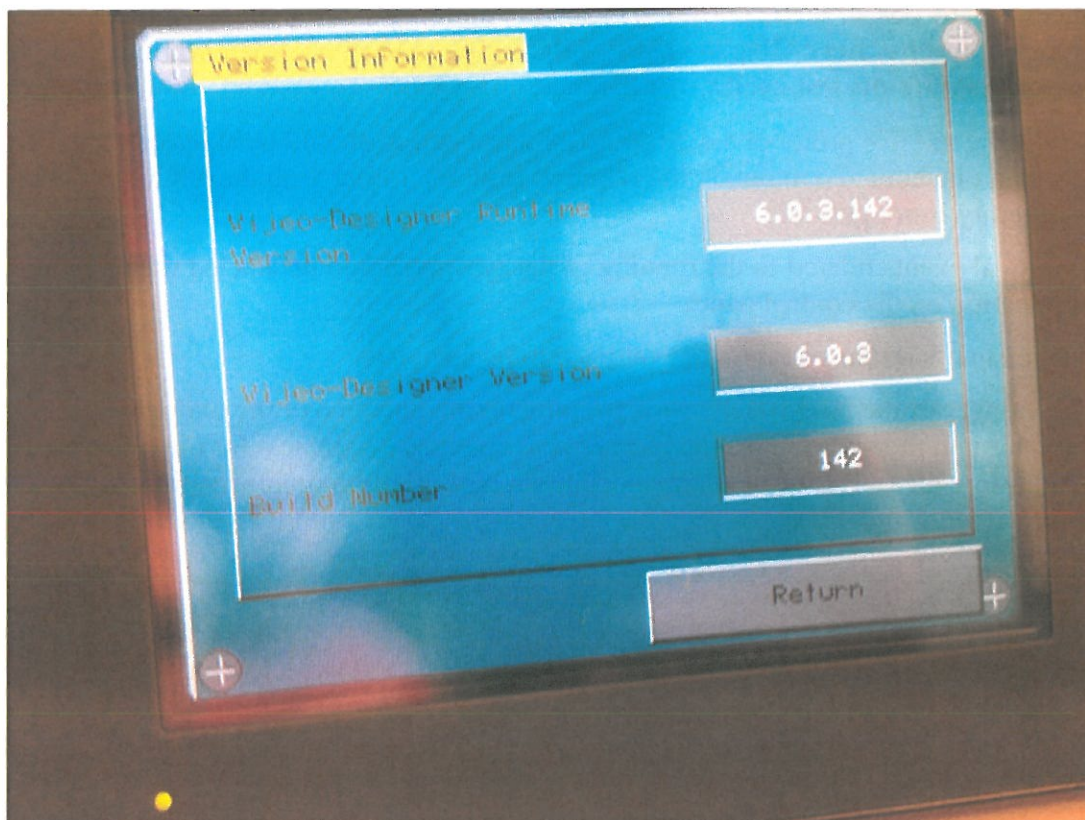


Figure 1 Screen shot of the software revisions

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